

*Vulpes velox*. By Harold J. Egoscue

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*Vulpes velox* (Say, 1823)

Swift Fox

*Canis velox* Say, 1823:486-487. Type locality, South Platte River, Colorado.

*Vulpes velox* Audubon and Bachman, 1851, Vol. 2:13, first use of current name combination.

**CONTEXT AND CONTENT.** Order Carnivora, Family Canidae, Genus *Vulpes* in which there are 13 species (12, if *V. fulva* and *V. vulpes* are combined). Van Gelder (1978) suggests the most appropriate current classification would include *Vulpes* as a subgenus of *Canis*. Two subspecies of *Vulpes velox* are recognized.

*V. v. velox* (Say, 1823), see above.

*V. v. hebes* Merriam, 1902:73. Type locality, Calgary, Alberta, Canada.

**DIAGNOSIS.** Blackish nose patches distinguish *Vulpes velox* from all Old World species of *Vulpes* except *V. cana* and *V. ruppelli*; from the former, *V. velox* differs in lacking a dark mid-dorsal stripe and in larger size (condylobasal length about 111 mm compared to about 90 mm for *V. cana*), and from *V. ruppelli* in its black-tipped tail. See McGrew (1979) for other details and comparisons.

The swift fox (figure 1) can be distinguished from other North American vulpines except the kit fox, *Vulpes macrotis*, by its small size and black-tipped tail (Both taxa are native in three states, namely Colorado, New Mexico, and Texas). Among differences used by Thornton and Creel (1975) to separate adult *V. macrotis* from *V. velox* were: (1) longer ears (80.7 to 85.1 mm) with ear bases close to the midline of the skull, as opposed to shorter (58.3 to 67.5 mm) and more widely spaced ears of *V. velox*; (2) head of the kit fox comparatively broader between the eyes and with a narrower snout, compared with the "more rounded and dog-like" head of the swift fox; and (3) length of tail (expressed as percentage of length of body) significantly longer for *V. macrotis* (average 62%) than the swift fox (average 52%). There was no overlap in ear measurements and almost no overlap in the tail to body ratio. Thornton and Creel (1975) provided frontal-view sketches that compare ear and head characteristics of the two taxa. Seton (1937) also clearly illustrated these differences plus the difference in relative length of the tails.

Cranial measurements of *V. velox* and *V. macrotis* compared by Thornton et al. (1971) support the above descriptive differences in head proportions.

**GENERAL CHARACTERISTICS.** Audubon and Bachman (1854) and Baird (1858) described this species in detail. Bailey (1926; 1932) described the winter pelage of the swift fox as long and dense and mainly dark buffy gray above, with orange-tan sides, legs, and lower surface of the tail. The throat, chest, and belly are light colored (buff to pure white). Summer fur is short and harsh and more reddish gray. There is a blackish-brown spot on each side of the snout and the tip of the tail is usually black. The foot pads are almost concealed by fur.

Average weights (kg) of 19 adult males and 14 adult females from Oklahoma, Kansas, New Mexico, and Texas were 2.44 (2.18 to 2.95) and 2.25 (1.8 to 2.27), respectively (Kilgore, 1969). Standard measurements (mean and range in mm) of the above adults combined with those of Thornton and Creel (1975) were as follows (females follow males): total length, 787.9 (735 to 880) and 776 (702 to 850); length of tail, 264.2 (240 to 350) and 274.5 (251 to 350); length of hindfoot 129.2 (114 to 135) and 122.2 (113 to 128); length of ear from notch, 62.4 (56 to 75) and 63.5 (58 to 68), respectively. Some of the measurements taken by Thornton and Creel (1975) were from live animals, so their data are not strictly comparable with data obtained from carcasses. In most body measurements males are about eight percent heavier and average

slightly larger than females. An average adult stands about 30 to 32 cm high at the shoulder.

Cranial measurements given by Armstrong (1972) for three males and one female from Colorado are, respectively: condylobasal length, 114.5, 108.7, 109.7, 113.3; zygomatic breadth, 63.9, 63.6, 64.9, 63.0; interorbital constriction, 24.7, 24.0, 23.5, 24.0; postorbital constriction, 22.6, 25.2, 21.9, 22.5; length of nasals, 41.2, 36.1, 38.3, 41.7; length of maxillary tooththrow, 54.1, 51.6, 51.8, 52.7. The skull is illustrated in figure 2.

**DISTRIBUTION.** The range of the swift fox (figure 3) reached its northern limits in the prairie provinces of central Canada, perhaps in extreme southeastern British Columbia (Anthony, 1928; Seton, 1937; Anderson, 1947); southern Alberta as far north as Calgary (Merriam, 1902; Anderson, 1947; Rand, 1948); southern Saskatchewan north to the Saskatchewan River (Yanchinski, 1955; Miller and Kellogg, 1955); and southwestern Manitoba (Seton, 1909; Soper, 1961). By 1900, *V. velox* had disappeared or become very rare in most parts of Canada; the last authenticated record was for an animal trapped in 1927 in Saskatchewan (Symons, 1956). Banfield (1974) stated that *V. velox* was extinct in Canada, but several recent sightings and road kills thought to be of swift foxes have been reported from Saskatchewan (Kerwin, 1972; Looman, 1972; Wilkinson, 1972; Shulver, 1972).

In the United States, *V. velox* occurred east of the Rocky Mountains from Montana (Bailey and Bailey, 1918; Hoffmann and Pattie, 1968) to extreme western Minnesota (Swanson et al., 1945) and south at least to Midland County in west-central Texas (Davis, 1974) and southeastern New Mexico (Best, 1971). The western limits of the swift fox in Wyoming were updated by Long (1965). Its historical eastern boundaries in the Dakotas are based primarily on fur catch reports of the mid to late 1800's (Bailey, 1926).



FIGURE 1. Photograph of adult *Vulpes velox* taken in 1975 by Ken Stiebben in Wallace County, Kansas (Courtesy of the Kansas Fish and Game Commission).

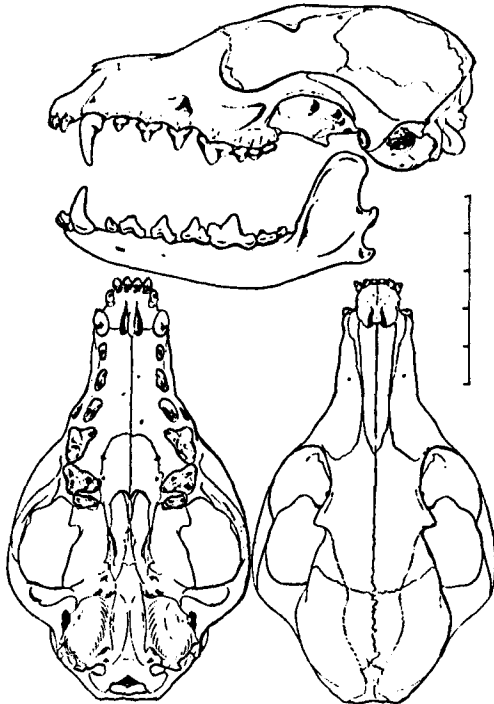


FIGURE 2. Lateral, ventral, and dorsal views of the skull of male *Vulpes velox* from First View, Cheyenne Co., Colorado, K.U. no. 1601 (Hall, 1955). Scale represents 50 mm.

Range limits not documented by specimens but included in most distribution maps on the basis of statements in the older literature are southeastern British Columbia, western Minnesota, and western Iowa. Swanson *et al.* (1945) did not list the species for Minnesota but thought it peculiar that the swift fox could have been abundant 11 km away in North Dakota without occasionally venturing into Minnesota.

The only basis for placing *V. velox* in southern British Columbia probably originated with Canadian Government Fur Lists for the years 1919–1922, which listed the swift fox as “Fox, other” to distinguish it from red and arctic foxes (Seton, 1937). According to the above reports, the 661 “Fox, other” pelts for the three fur seasons came chiefly from Alberta with “very few” from British Columbia. The range map in Hall and Kelson (1959) shows *V. v. hebes* in southeastern British Columbia, but Cowan and Guiguet (1956) made no mention of this fox for the province. Hoffmann *et al.* (1969) stated “that plotting of the range of the swift fox across northwest Montana to southeastern British Columbia by Hall and Kelson is not based on specimens and is erroneous.” The last confirmed records for *V. velox* from northwestern Montana came from Glacier County, only a few air miles from the southeastern tip of British Columbia, but the mountainous nature of the intervening terrain seems unsuited for swift foxes. On the other hand, Weaver and Clements (1938) stated that the major grasslands of North America once included part of southeastern British Columbia; whether it was ever occupied by *V. velox* may never be settled. With the advent of modern agricultural and predator control practices, this fox and its habitat disappeared so rapidly that the pristine limits of both were poorly documented and are still subject to argument.

Evidence for including western Iowa in the historical range of *V. velox* is also scanty and based primarily on statements such as Allen’s (1870) who wrote “An animal described to me as the ‘Swift,’ which occurs here [western Iowa] more or less frequently, is undoubtedly this species . . . The character of the country in western Iowa differs little from that of eastern Nebraska, where this species is well known. . . .” No records are available from Nebraskan counties bordering Iowa, the nearest being about 120 km west (Jones, 1964). Bowles (1975) thought it “unlikely” that the swift fox occurred in Iowa within historic times and placed it on his hypothetical list.

Barnes (1922, 1927) listed the kit fox in Utah as *V. velox* and mentioned its occurrence in the Uinta Basin (this was apparently

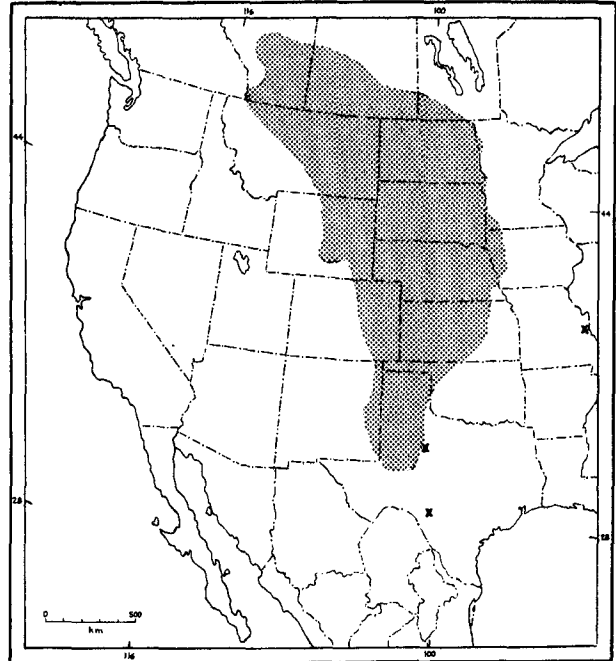


FIGURE 3. Historical range of *Vulpes velox*. X’s mark locations where fossil and subfossil remains of the species have been discovered.

the basis for including northeastern Utah within the geographic range of *V. velox* by Hall and Kelson, 1959). Kit foxes from eastern Utah and adjacent places in Colorado belong to the species *V. macrotis* (Miller and McCoy, 1965; McGrew, 1977).

**FOSSIL RECORD.** Three fossil teeth belonging to a tiny fox identified as *Vulpes* near *V. velox* were among early Blancan (late Pliocene) mammal remains of the Beck Ranch local fauna, Scurry County, Texas, a locality within the present range of the species (Dalquest, 1978). Swift fox remains were also found in Pleistocene deposits of Edwards County, Texas (Dalquest *et al.*, 1969), and cave deposits dated 5,478 to 3,478 years BP in eastern Missouri (Parmalee *et al.*, 1969). These localities place *V. velox* 322 km southeast and about 645 km east of its historical limits, respectively, and probably reflect the effects of changing Pleistocene climates on the grassland associations and faunas of Middle America. Such discoveries stress the potential importance of *V. velox* as an indicator species identifying the former extent of short-grass and mixed-grass prairies.

**FORM AND FUNCTION.** Hildebrand (1954) did not include *V. velox* in his comparisons of postcranial skeletons of recent Canidae, although his conclusions about *Vulpes*, particularly *V. macrotis*, probably apply to *V. velox*. The skeleton of *Vulpes* is slender and as much modified for running as that of any other canid. *Vulpes macrotis* has a longer humerus and femur relative to the total length of its respective limbs, but has relatively shorter legs than the red fox. Hildebrand thought this “may be associated with reduced capabilities for speed in the smaller fox.”

The dental formula of an adult is  $i\ 3/3, c\ 1/1, p\ 4/4,$  and  $m\ 2/3,$  total 42.

The swift fox has eight evenly spaced mammae.

**ONTOGENY AND REPRODUCTION.** Except as noted, data on breeding and growth and development of swift foxes is from Kilgore (1969). The species lives in pairs or occasionally as trios of one male and two females. In Oklahoma, breeding occurs in late December or early January, and most litters are born in March or early April; the latest pregnancy recorded was 2 April. Gestation is unknown but presumably approximates the 49 to 50 day gestation of the red fox (Asdell, 1964). Litter size varies from three to six. The swift fox is monestrous.

Neonates have not been described. Mean and extreme measurements in mm of eight near-term embryos were: total length, 155 (149 to 165); length of tail, 47 (43 to 52); length of hindfoot,

20.9 (20 to 21); length of ear, 6.4 (6 to 7), which are about 20%, 17%, 17%, and 10% of these respective measurements for an adult of average size. The eyes and ears open about day 10 to 15. Beyond this, the development of unweaned swift foxes has not been reported. Whelps are nutritionally weaned about six to seven weeks postpartum, and at this age are covered by short wavy fur with dorsal guard hairs that are longest on the posterior portion of the body. The muzzle and tail tip are darkened. At two months of age, young foxes resemble adults, although the pelage is finer. By August young of the year approximate adults in size and pelage. Pups that weighed about 0.23 kg in April weighed almost 2.27 kg in September.

Young remain with the parents until August or early September and probably stay longer in the den(s) where they are raised than other North American canids, except *V. macrotis* (Egoscue, 1962). Kilgore (1969) suggested that swift foxes pair and breed the first breeding season following birth, but this needs confirmation. Red foxes of both sexes breed at just under one year of age in captivity (Bassett, 1957).

**ECOLOGY.** The swift fox is the smallest member of a prairie adapted trio of canids that included the coyote subspecies *Canis latrans latrans*, and the now extinct buffalo wolf, *C. lupus nubilus*.

When settlement of the Midwest began, *V. velox* probably was common over most of the area then covered by short-grass and mid-grass prairies (see Shelford, 1963). Eastern limits of the swift fox are poorly known, but statements in older literature suggest that suitable habitat for *V. velox* penetrated at least short distances into the drier, well drained parts of some tall grassland associations in western Iowa (Allen, 1870) and possibly western Minnesota (Swanson *et al.*, 1945).

Habitat requirements and population densities of the species based on studies in undisturbed areas were never made. Less than 50 years after settlement began, conversion of the prairie to farmland, overgrazing by livestock, and poisoning campaigns aimed mainly against wolves, had extirpated the swift fox or reduced it to a rarity. For reasons not fully understood, but probably related in part to changes in predator control methods and policies, swift fox populations began to slowly recover in the mid 1950's in Kansas (Martin and Sternberg, 1955), where it was thought extinct (Cockrum, 1952); in South Dakota (Van Ballenberghe, 1975), after a hiatus of 60 years; in North Dakota (Pfeifer and Hibbard, 1970), following an apparent absence since 1915; in Oklahoma, where Glass (1959) reported the first records known for the state; in Nebraska, where the first specimens since 1900 were collected in the 1950's (Jones, 1964) and in 1966 (Blus *et al.*, 1967); in Wyoming, with an interval of over 50 years between reported specimens (Long, 1965); and in Montana, where the first specimen since the early 1900's was found in 1978 (Kilgore, personal communication).

Although significant expanses of short-grass and mixed-grass prairie remain in Colorado (Armstrong, 1972), Nebraska (Jones, 1964) and elsewhere, most of it is held in perpetual disclimax by overgrazing, and is much modified. Studies that measure acceptable ecological parameters for swift foxes based on present-day conditions are few. A basic requirement seems to be suitable den sites, especially for whelping. Beginning about 1802, with the Lewis and Clark reference to this species as "the burrowing fox" (C oues, 1893), many early naturalists and zoologists (Audubon and Bachman, 1851; Seton, 1909, 1937) have emphasized that *V. velox* is one of the most burrow-dependent canids in North America. Swift foxes may modify and use the burrows of other mammals such as prairie dogs (Kilgore, 1969) or dig their own. Most entrances to *V. velox* dens are too narrow for coyotes and badgers, suggesting that swift foxes do not use dens dug by larger species. Typical natal dens have two or more entrances (Cutter, 1958a; Kilgore, 1969). If undisturbed, favored sites are used repeatedly, with each resident usually making some repairs or modifications.

Of 35 dens in Oklahoma (Kilgore, 1969), 16 were in cultivated fields, 15 in short-grass pastures, two in a cemetery, and one in a culvert. Most dens in cultivated fields were simple, one-entrance, short tunnels dug for temporary use. Entrances closed by plowing or disking were seldom reopened except occasionally just prior to whelping season. Burrows in short-grass pastures usually had multiple entrances and most whelping dens were in pastures. Regardless of the habitat, dens were frequently, though not invariably, located on higher ground. Certain favorite mounds appeared to be created almost entirely from soil brought to the surface as dens were modified or renovated by successive generations of occupants. Kilgore (1969) figured an occupied den

which had seven entrances and a complex network of tunnels ending in two separate chambers that were 100 and 74 cm below the surface and were bare of litter and nest material. Pups removed from one den were found in a grass-lined chamber (Seton, 1937).

Cutter (1958a) reported on 25 occupied *V. velox* dens in Texas; all were in open, sparsely vegetated habitats on sloping plains, hill tops, and other well drained situations. Nineteen dens were in overgrazed pastures, two were in plowed fields, and four were along fence rows. The ratio of pastureland to cultivated fields was much higher in Texas than in Oklahoma, where Kilgore (1969) found almost 50% of the swift fox dens in plowed ground. A den excavated by Cutter had one entrance 20 cm in diameter, a total of 3.8 m of open tunnels, and a chamber 30.5 cm wide by 23 cm high located 81 cm below the surface. Cutter found two to five dens in each of several 64.75 ha pastures; three dens were within 100 m of human habitations.

Swift fox dens, particularly the larger, complex, regularly occupied systems, are ecological entities in their own right and provide breeding sites, sources of food, and a place of refuge for numerous kinds of invertebrates and vertebrates. Kilgore (1969) listed centipedes, several species of Coleoptera (including scavengers attracted to animal remains and scats), numerous spiders, pulicid fleas, and a Great Plains toad (*Bufo cognatus*) from occupied burrows. In abandoned dens, Kilgore found several invertebrates not found in occupied dens, plus a prairie rattlesnake (*Crotalus viridis*) and two deer mice (*Peromyscus maniculatus*). Burrowing owls (*Speotyto cunicularia*) commonly live in abandoned dens, and both Cutter (1958a) and Kilgore (1969) reported striped skunks (*Mephitis mephitis*) at vacant den sites.

Practically nothing is known about the food habits of *V. velox* in the northern part of its range beyond the facts that mice and grasshoppers are eaten (Baird, 1858) and it was adept at capturing prairie chickens in the snow (Seton, 1937). A list of identified foods represented in 488 scats and seven stomachs of swift foxes from western Oklahoma included 13 species of mammals, four of birds, one amphibian, one reptile, and about 30 kinds of invertebrates (Kilgore, 1969). Both this study and Cutter's (1958b) report revealed a strong dependence on mammals, the bulk of which were lagomorphs. Black-tailed jackrabbits were the largest prey captured. Ground-dwelling birds, lizards (especially in Texas), and orthopteran insects are also important food sources. Grass is regularly eaten.

Swift foxes normally host the fleas *Pulex irritans* and *P. simulans* (Jordan and Rothschild, 1908; Rapp, 1962; Kilgore, 1969), the former being the most numerous in a small sample collected by Kilgore (1969). Holland (1949) listed *P. irritans* from *V. velox hebes* in Canada. Fleas probably acquired from prey (that is, *Opisocrostis hirsutus*, which normally infests black-tailed prairie dogs, *Cynomys ludovicianus*) were also found (Kilgore, 1969) and provide circumstantial evidence about food habits. Kilgore (1969) also collected the tick, *Ixodes kingi*, from three of 18 foxes examined and provided a list of three protozoans, two flatworms, and five nematodes based on his study and on the literature. *Dipylidium caninum* was the most common cestode, of which the flea *Pulex irritans* is an intermediate host.

Mortality factors affecting swift foxes other than those caused by man are poorly known. Coyotes and, perhaps formerly, wolves are suspected predators of swift foxes. The dependency on dens by adult *V. velox* implies vulnerability to predation and the need for a safe daytime retreat in habitat that offers little natural cover.

Swift foxes are killed crossing roads and highways (Kilgore, 1969; Best, 1971), shot by hunters and farmers, run over by farm implements (Kilgore, 1969), and inadvertently poisoned and trapped during campaigns directed against wolves and coyotes (Seton, 1937; Bunker, 1940; Taylor and Davis, 1947; Robinson, 1953). Glass (1959) reported instances where *V. velox* dens were excavated and the foxes secured and kept as pets. Kilgore (1969) discovered unexplained mortality among young swift foxes unrelated to human activity.

Although frequently mentioned in reports by early fur traders (see Bailey, 1926), swift fox fur is not valued commercially. Examples of prices summarized by Seton (1937) varied from 30 cents each in 1906 to an average of \$8.35 per skin for 661 Canadian pelts sold during the fur boom that followed World War I. Over 5,000 "kits" were sold at a London auction in 1905. According to Arnold (1925) swift and kit fox pelts were dyed and used extensively to imitate better quality foxes.

Swift foxes are often kept in zoos where they are easily maintained, although they seldom rear young in exhibit cages unless a secure den is provided. Longevity in the wild is unknown, but

Crandall (1964) reported a maximum of 12 years, 9 months, 13 days for the species at the Bronx Zoo, and Mann (1930) gave 10 years, 4 months for one at the National Zoological Park.

**BEHAVIOR.** Swift foxes are essentially nocturnal; daytime activities above ground are usually confined to the immediate vicinity of the den. Undisturbed adults seen outside their burrows after sunup are often resting or basking in a curled up position. Kilgore (1969) noted that swift foxes sunned themselves more often about midday during winter months but shifted to mornings or late afternoons in the warmer months. Minimal foraging in daytime is suggested by low percentage occurrences of certain available diurnal prey such as *Spermophilus tridecemlineatus* and *Cynomys ludovicianus* in scats and stomachs (Kilgore, 1969; Cutter, 1958b), although both sciurids might have been scavenged as carrion.

Early observers (Mead, 1898; Seton, 1909) noted that swift foxes lived in pairs and suggested they mated for life. The first observation has been confirmed many times but data on mate selection and the duration of pair bonds are lacking. Males apparently assist in provisioning dependent young (Seton, 1909), but this aspect of swift fox behavior has not been studied. Both parents were observed attempting to decoy a dog away from the burrow containing their pups (Seton, 1937).

Seton (1937) aptly characterized *V. velox* as "The least cunning of our foxes. . . ." Their ready acceptance of poison baits put out for wolves and coyotes (Bunker, 1940), the ease with which they can be trapped (Bailey, 1926), and their willingness to den near human habitations (Cutter, 1958a) all tend to confirm an unsuspecting nature.

**GENETICS.** The swift fox has a diploid number of 50 chromosomes (Thornton and Creel, 1975) that includes four pairs of large metacentrics and 20 pairs of submetacentrics. The X chromosome is a medium-size metacentric. The Y chromosome is easily identified as the smallest submetacentric. Thornton and Creel (1975) found a close similarity between the karyotypes of *V. velox* and *V. macrotis*.

Although based on a limited sample, electrophoretograms of serum protein and hemoglobin fractions from these two taxa are recognizably different (Thornton and Creel, 1975). This evidence, combined with differences in external characteristics, supports the conclusion that populations of *V. macrotis* and *V. velox* are specifically distinct. Thornton and Creel (1975) suggested that the two taxa are parapatric, rather than allopatric, in western Texas and eastern New Mexico. The question of clinal variation as an explanation for differences between the kit fox and swift fox is not supported by their findings (Creel and Thornton, 1971; Thornton and Creel, 1975).

Rohwer and Kilgore (1973) found evidence of hybridization from the region along the interface between the ranges of *V. velox* and *V. macrotis*, especially where the high plains grassland contacts desert grassland in the Pecos drainage of eastern New Mexico. Four of 28 (14.3%) of the specimens from this area were centrally intermediate, but specimens with intermediate skull morphology did not extend more than 40 to 48 km to either side of the presumed line of contact.

**REMARKS.** The taxonomic status of *V. velox* and *V. macrotis* was long questioned (Seton, 1937; Hall, 1946), but specimens were lacking from areas where the ranges of the two foxes met. Several authors (Blair *et al.*, 1968; Lechleitner, 1969; Bueler, 1973) accepted the viewpoint that the two species were probably conspecific. Others (Miller and Kellogg, 1955; Hall and Kelson, 1959; Burt and Grossenheider, 1964; Armstrong, 1972) listed the kit fox and swift fox as full species based mainly on lack of known intergradation. Recent studies suggest that the species may be readily separable and retain their identities despite occasional hybridization (Rohwer and Kilgore, 1973) where the ranges meet in west-central Texas (Thornton and Creel, 1975) and overlap in southeastern New Mexico (Packard and Bowers, 1970). The species question seems clarified, but a revision at the subspecies level is still needed. The status, geographical limits, and range of variation for *Vulpes velox hebes* are very poorly known, and its southern limits as mapped by Hall and Kelson (1959) were not based on specimens. Long and Long (1964) provisionally referred specimens from Teton and Glacier counties, Montana, to the nominate race based on comparisons with Colorado material. This extends the range of *V. v. velox* northwest nearly to Canada. If areas where the swift fox became rare or was extirpated in the northern Great Plains continue to be reoccupied by animals moving in from the south (e.g. the influx of

swift foxes from Nebraska into South Dakota as suggested by Van Ballenberghe, 1975) the original limits of the two subspecies may never be known.

The vernaculars, "swift fox" and "kit fox," have been used interchangeably. In accordance with Hall *et al.* (1957), swift fox is the preferred common name for *V. velox*. "Swift" refers to the species' supposed speed. The name "kit" refers to the animal's size and is probably based on the widespread usage of "kit" by fur dealers, fur farmers, and trappers to designate the small young of any furbearer.

The relative ethnological importance of kit fox [swift fox] associations, one of several age-graded societies among Plains Indians, was discussed by Lowie (1963). Mandan kit foxes were comprised only of unmarried youths; Arapaho kit foxes were a preliminary order of boys too young to belong to other societies; members of the Hidatsa counterpart of the Arapaho group were slightly older; but among Piegans, the kit fox society ranked high and was responsible for sacred functions. Both rank and file of the Oglala kit foxes wore kit fox skin necklaces and forehead bands decorated with kit fox jaw bones.

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Principal editors of this account were S. Anderson and Daniel F. Williams.

H. J. EGOSCUE, SMITHSONIAN INSTITUTION, NATIONAL ZOOLOGICAL PARK, WASHINGTON, D.C. 20008.